APPENDIX D

CASE STUDIES ON THE BENEFITS OF THE PHASE I STORM WATER PERMIT PROGRAM

Table of Contents

Municipal Case Studies

Industrial case studies:

National Storm Water Database: A Case Study of a National Incentive

Successful Elements Related to Phase I Program:

- Both Phase I and Phase II communities contribute case studies to the National Storm Water database so other municipalities can learn about the effectiveness of BMP implementation.
- The storm water database allows for municipalities from all over the country to compare and contrast study results to further enhance the protection of the environment through experience and education.

What is the purpose of the National Storm Water Database?

This project is being conducted under a cooperative agreement between the American Society of Civil Engineers (ASCE) and the U.S. Environmental Protection Agency. The purpose of the project is to improve water quality nationwide by sharing consistent and transferable information on storm water best management practices. The database will help water quality professionals across the United States to learn about successful BMPs and apply proven methods to local water quality projects. By adding individual BMP study findings to the database, users can enrich its usefulness for a national audience.

Location:
Nationwide

Area:
11 States

Affected waters:
Waters of the U.S.

What information is considered?

Representative information provided for BMPs includes test site location, researcher contact data, watershed characteristics, regional climate statistics, BMP design parameters, monitoring equipment types, and monitoring data such as precipitation, flow, and water quality.

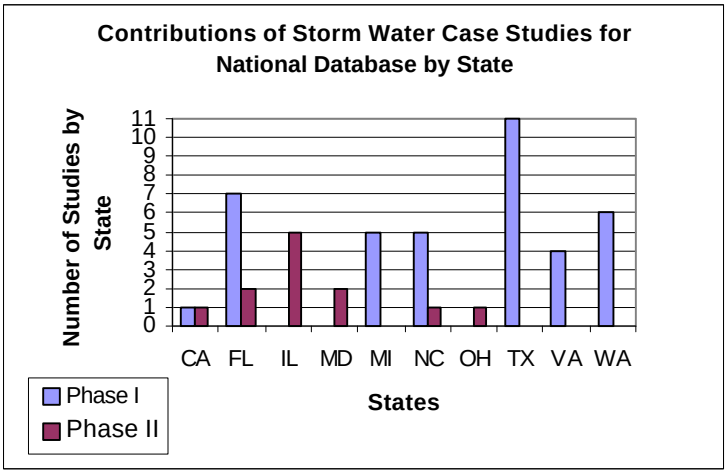
What are the benefits?

- Provides access to BMP performance information for comparison to local studies.
- Allows individual investigators to develop project-specific BMP performance databases.
- Promotes technical design improvements in storm water runoff management methods.
- Offers a simple way to share findings with the water quality community.
- Serves planners, engineers, scientists, officials, and citizens involved in water quality projects.
- Easy to understand and use.

Who has contributed to the database?

Communities distributed among 11 States have contributed BMP effectiveness information for the database. To date, 73 percent of the case studies submitted are from Phase I communities (18 communities in all). Phase II contributors make up the remaining percentage of case studies submitted, with a total of 12 cities participating in the project.

BMP designers, owners, and operators are invited to submit their BMP study data for incorporation into the storm water database. This is an ongoing invitation to further enhance the range and applicability of the national storm water BMP database.



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Austin, Texas: A Stormwater Runoff Abatement Project Within an Existing Urban Watershed

***Successful Elements Related to Phase I Program*:**

- Retrofit projects remove pollutants from the urban watershed, and can enhance wildlife habitat, neighborhood aesthetics, and recreational opportunities.
- The Central Park retrofit project provides 44 percent to 79 percent removal of key pollutants.

Faced with a rapidly growing population, urban development, and rising concerns over nonpoint sources of pollution, city managers in Austin, Texas, require all new development to implement storm water best management practices (BMPs). Older existing urban watersheds, however, still need water quality controls. The City of Austin Urban Watershed Retrofit program was created to evaluate existing urban watersheds to determine appropriate storm water controls that reduce pollutants through settling, filtration, flotation, absorption, and/or biological processes. Since the mid-1990s, the city has undertaken numerous retrofit storm water abatement projects that provide storm water management in areas where once there was no management, including some areas that correspond with urban redevelopment efforts. The city initiated an optional urban watershed ordinance fee policy, under which private developers can opt to contribute to a city-run fund instead of installing on-site water quality controls. These developer fees are used in addition to a portion of the city's monthly drainage fees to fund storm water projects, including those that retrofit older urban areas.

Location:
Austin, TX
Population:
613,458
Area:
225.4 square miles
Affected Waters:
Austin-Travis Lakes Watershed, Colorado River, Town Lake

One recent example of an Austin retrofit project is the Central Park area. Central Park is a joint public/private enterprise between the State of Texas and a private developer. The project covers a total of 164 acres and incorporates 39 acres of mixed-use development, including houses, shops, businesses, and 10 acres of park and public spaces with hike and bike trails and picnic areas. Integrated into the project are three storm water quality ponds designed to provide environmental, aesthetic, and economic benefits. Fifty-four percent of the area draining to the ponds is covered by impervious surfaces. Rainwater that falls on the land area drains to the wet ponds, carrying trash, litter, and pollutants with it. During storms, approximately 300,000 cubic feet of rainfall runoff is stored in the ponds and released slowly to reduce flooding and erosion downstream in Waller Creek. Two waterfalls between the ponds increase oxygen in the water for fish and other aquatic life. The best pollutant removal occurs when runoff remains in the ponds for a duration of 2 weeks or more. Sediment and other pollutants settle out of the water and are not discharged to Waller Creek or Town Lake. Periodically, the pollutants that have settled to the bottom of the pond, in the "muck," are removed by dredging. The treated water is then released from the ponds to flow to the Hemphill branch of the Waller Creek and eventually to Town Lake. The estimated pollutant removal is provided in the adjacent text box.

Water Quality Parameter	Removal Efficiency (measured*)	Pounds Prevented (est.) per year
Total suspended solids	79%	36,400 to 50,000
Nitrate/nitrite as N	65%	55 to 275
Total Phosphorus	44%	55 to 2,000
Lead	97%	5 to 50
Zinc	65%	10 to 150

In addtion, the wet water ponds remove 57% of the total petroleum hydrocarbons, 70% of the copper, 71% of the DDTs, 57% of the chemical oxygen demand, and 68% of the PAHs.

* Removal efficiency was calculated based on water quality measured at one of several inflows and at the outflow. The other inflows were accounted for in water quality models used to estimate loads captured.

The construction of the wet ponds was funded by the city of Austin, the developer, and the U.S. Environmental Protection Agency through a matching section 319 grant for monitoring the ponds and installing educational signs. The total cost of the project was $584,000.

The city of Austin continues to evaluate and implement projects in developed urban areas to limit erosion and flooding and to protect or improve water quality.

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Caltrans' General Permit: Flexibility of NPDES Program Promotes a Comprehensive Statewide Storm Water Management Approach

Successful Elements Related to Phase I Program:

- Streamlines permit administration for department of transportation permittee.
- Improves watershed-level transportation planning.
- Encourages partnerships with local, State, and regional regulators.

The flexibility of the Phase I construction program and NPDES regulations resulted in the State of California developing a highway construction general permit. This newly promulgated permit is specific to the requirements for transportation construction and was developed to standardize highway construction permitting to foster quicker and more cost-effective compliance.

Location:
State of California

Affected area:
155,973.2 sq mi

Population:
32,666,550
(May 1, 1998 U.S. Census)

Under the Phase I rule, departments of transportation (DOTs) are considered municipal separate storm sewer system (MS4) operators and must obtain the required permits. Because of the nature of the regulations and DOT MS4 systems, many State DOTs held numerous MS4 permits in various Phase I cities. In 1996, to implement a more uniform storm water program, Caltrans requested that the California State NPDES permitting authority, the State Water Resources Control Board (SWRCB), consider adopting a *single* NPDES permit for all storm water discharges from Caltrans properties, projects, and activities. Over the next 3 years, Caltrans, EPA Region 9, and the SWRCB worked together to develop the required permit language. On July 15, 1999, the SWRCB approved the final Caltrans statewide NPDES permit. This permit covers the Construction General Permit (CGP) and MS4 permit requirements as well. Prior to that time, Caltrans had held nine different MS4 permits and there had been no statewide, standard procedure for CGP compliance.

Caltrans is confident that it can meet the challenges of its new permit through the implementation of its new statewide comprehensive Storm Water Management Program (SWMP). The SWMP requires that the most advanced best management practices, design/construction techniques, and maintenance procedures be used on all Caltrans properties. This creates uniformity in site plans throughout the State. To use the most efficient erosion and sediment control and vegetation management BMPs available, Caltrans is conducting research and monitoring studies. The resulting information will be available to other DOTs and permittees. Caltrans also is developing a GIS-based database to provide information on any potentially impacted watersheds, water bodies, and associated water quality standards. The program will assist in the new watershed-level highway construction project planning process outlined in the SWMP and encourage coordination between regulators, local community groups, municipalities, and transportation entities. Caltrans is developing a comprehensive education and awareness program for its personnel. This program includes guidebooks for staff and contractors. A Storm Water Compliance Review Task Force also has been established to conduct in-house compliance reviews on highway construction sites and other Caltrans facilities.

By using the flexibility of the NPDES regulations and working with the permitting authority, Caltrans was able to develop a standardized, statewide permit without the standard requirements that do not apply to a DOT. This approach will improve the overall efficiency of the program, better ensure compliance, and protect water quality in California.

Caltrans' SWMP Components:

- Standardized watershed planning and use of construction BMPs
- Research projects
- GIS planning tools
- Guidebooks for staff and contractors
- Education and awareness program
- Internal compliance task force

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Sources:
www.dot.ca.gov/hg/environmental/stormwater
U.S. Census Bureau,< www.census.gov>

Charles River: Discovering and Removing Illicit Connections

Successful Elements Related to Phase I Program:

- Removal of illicit connections has eliminated discharge of about 1 million gallons of contaminated flow per day.
- In 1999, the Lower Charles River met its designated use during dry-weather periods for swimming 94 percent of the time, and the boating use is safe virtually all of the time.

The Charles River, which flows 80 miles from Hopkinton to Boston Harbor, is one of the busiest recreational rivers in the world. Unfortunately, by the early 1990s the quality and quantity of safe swimming and boating opportunities had been reduced by multiple pollutant sources, including storm water runoff and dry-weather illicit connections. To meet the goal of restoring the Charles River to fishable and swimmable status by Earth Day 2005, EPA is working closely with several Federal, State, and local agencies through a number of regulatory programs.

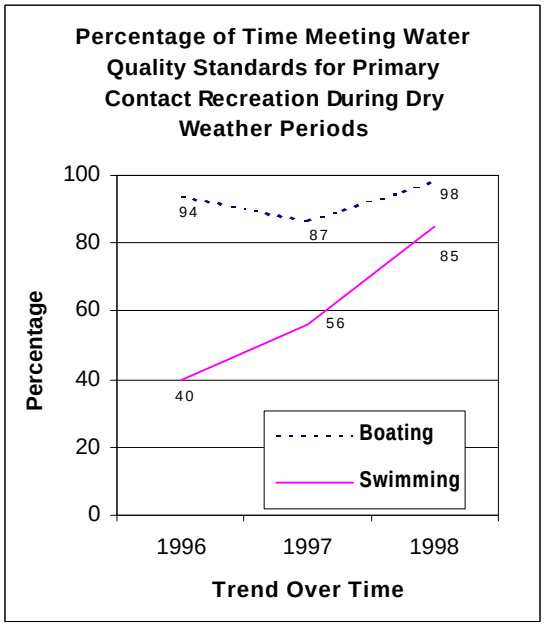
One of the major water quality problems on the lower Charles River comes from high bacteria levels during *non-rainfall* periods in and around Boston. Boston is the only community along the Charles River that is subject to Phase I storm water regulations. Its Phase I storm water permit requires Boston to investigate and eliminate all illicit discharges over the permit's 5-year term. In a recent investigation effort, Boston's dry-weather monitoring found a sanitary sewer discharging 72,000 gallons per day of sewage into a storm drain (one of three open connections between sanitary sewers and storm drains), 22 other illicit connections, and one broken sanitary sewer drain. As of spring 1999, repairs had been completed to remove those pollutant sources.

Location:
Boston, Massachusetts

Area:
48 square miles

Affected Waters:
Lower Charles River

Since the beginning of the Charles River initiative, a regional initiative that entails better storm water, sanitary, and combined sewer management for communities along the river, there has been a steady increase in EPA's environmental report card for the river—from a D to a B- rating over a three-year period. The report card is based on a summary of the city's annual monthly water quality monitoring results. Improvements in the river's dry-weather water quality since the inception of the initiative has been measured and includes a doubling of the days on which swimming standards for bacteria are being met. Additionally, the water quality standards for boating were met 100 percent of the time in 1999 during dry-weather periods. The trend since the implementation of illicit connection management has been a steady improvement of the dry-weather water quality of the Charles River.



Boston's action to inspect city storm drains and pipes is being embraced by future Phase II storm water cities discharging to the Charles River. Many of these have largely completed their illicit connection investigations and are now evaluating or implementing programs to rehabilitate illicit connections. According to EPA's Bill Walsh-Rogalski, illicit connection management by Boston and the other communities on the lower 10 miles of the Charles has stopped more than 1 million gallons of raw sewage from discharging daily into the river.

Because the water quality of the Charles River is a regional concern, Boston and the surrounding cities have developed a storm water workshop for the area's municipalities, including four State agencies that discharge storm water into the Charles River. Boston is also developing and conducting a demonstration project to examine the effectiveness of certain best management practices and to determine which ones are useful for protecting water quality during wet-weather periods, which includes CSO management.

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<www.epa.gov/region01/charles/200.html>

Controlling Construction Site Runoff in Chattanooga, Tennessee

Successful Elements Related to Phase I Program:

- Programmatic improvements have fostered contractor awareness of and compliance with the city's regulations. The city program is being used as a model for a similar statewide program.
- The city's free Erosion Control School has received a positive response from builders and has inspired other Tennessee cities to begin developing similar classes.

The city's response to Phase I requirements resulted in a model program that is being used as the foundation for the development of a statewide program by Tennessee's Department of Natural Resources. Chattanooga's local geography creates a basin into which storm water flows from other nearby jurisdictions and neighboring States. Prior to the program, changes in bed load of Mackey Creek "have been as high as 14 feet," according to Doug Fritz of the city's Storm Water Management Program. Chattanooga's erosion control program has three components: the erosion control requirements, contractor education, and enforcement. Aside from some exceptions for home gardening and landscaping and construction of stand-alone, single-family homes, people engaged in land-disturbing activities on sites of any size must obtain a city land disturbance permit and provide an erosion control plan before beginning work. Even those engaged in the excepted activities must follow the requirements of the ordinance although they do not need to obtain a permit or file a plan.

Location:
Chattanooga, Tennessee

Number of People Served by Permit:
152,466

Affected Area:
127.1 square miles

Exceeding current Federal regulations and anticipating the proposed Phase II rule, the city sets no lower limit for its program and requires erosion and sediment control measures to be functional before activity begins and to be maintained throughout construction. Clearing and grubbing must be kept to the minimum necessary for grading and equipment operation. Any disturbed area that is planned to remain idle for more than 30 days must be stabilized within 7 days of disturbance. When work is completed, the owner must make sure that the site is as erosion-free as practicable, establishing permanent vegetative cover where no other permanent stabilization technique has been used. Permanent certificates of occupancy are not granted until either the site is stabilized or a letter is received from the developer specifically detailing stabilization plans and time frames.

The city's public works staff discovered that achieving contractor compliance with these measures would be difficult. Chattanooga first developed education programs and attempted on-site training sessions. When these sessions did not produce significant improvement, the city, with initial assistance from the Chattanooga Home Builders' Association, established the Erosion Control School. In a free, 4-hour session, developers learn the city's requirements, as well as cost-effective ways to achieve compliance. Tests before and after the course measure learning, and those who pass the second test receive a certification card. In 5 years the school has certified nearly 300 people associated with all aspects of development in five years. The City has received positive responses not only from builders who have attended the class, but also from local officials who wish to develop similar programs in their municipalities.

Chattanooga also has a strong enforcement program. In the 1996–97 fiscal year the city conducted 2,211 site inspections while issuing 388 land disturbance permits. Fines of up to $500 per day can be imposed by the city's environmental court, and civil penalties of up to $5,000 per day can be imposed by the storm water manager. The city largely prefers to work with developers to show them how to achieve compliance and takes only repeat offenders to court. The possibility of punishment creates a strong incentive for those involved in land-clearing activities to attend the Erosion Control School.

To better demonstrate the benefits of the storm water management program, the city has completed an initial sampling and analysis program to track the water quality improvement from continuing development in the headwaters of area streams. Sampling is conducted for water quality and biological parameters. This baseline sampling will be available to assess new development in streams that bioassessment protocols rate as "good" biological communities. The city anticipates comparative results as early as next year.

Contact:
Douglas Fritz, Water Quality Supervisor, Chattanooga Department of Public Works, 423 757-0013.

Sources:
Natural Resources Defense Council, 1999
Telephone conversation with Douglas Fritz, 12/1/1999

Improving Construction Inspection Cost-Effectively

Successful Elements Related to Phase I Program:

- New Castle County's erosion and sediment controls reduce sediment in runoff on average of 84 percent.
- Delaware's Certified Construction Reviewer (CCR) program provides for more efficient inspections.

Because of the flexibility built into the Phase I MS4 storm water permit program, many local communities are developing innovative solutions to control storm water discharges. The Delaware Department of Natural Resource and Environmental Control (DNREC) Sediment and Storm Water Program illustrates how an aggressive inspection program built on privately employed inspectors can limit the water quality impacts of construction. The result is a win-win situation where the environment is protected, developers have less downtime, DNREC's workload is reasonable, and local jobs are created. To obtain the mandated construction inspection, developers can hire one of the hundreds of private inspectors licensed under the State's Certified Construction Reviewer (CCR) program, first implemented in 1992.

Location:
New Castle County, Delaware

Affected Area:
454.9 square miles

In New Castle County, a Phase I permitted county, the CCR program has been a successful component of their overall storm water management program. The County is currently enjoying economic growth and related commercial and residential development. Approximately 400 construction sites per year require development and implementation of a detailed Sediment and Storm Water Plan. Though limited to only three county government inspectors, the county has used the CCR program to leverage greater inspection coverage and increase compliance with Federal, State, and local construction requirements. Of the 400 construction starts, more than 75 percent are being inspected by CCRs for at least a portion of the site development. The CCRs inspect active sites weekly and submit a report to the developer/contractor and to the county. By incorporating CCRs, county staff time once spent on construction site inspections can now be spent on overseeing the private CCR inspection process. Through the CCR program, New Castle County is saving approximately $100,000 annually and the compliance rate with Delaware's Sediment and Storm Water Program requirements has increased.

Studies have shown that E&S construction controls in New Castle County reduce the sediment in runoff an average of 84 percent. For the 400 active construction sites in the county, the 84 percent efficiency equates to 600,000 tons of sediment *not* discharged into streams, lakes, and wetlands over the course of these projects. If this captured sediment were placed onto an area the size of a football field, it would bury the field completely under 400 feet of sediment.

At this time, DNREC is continuing to expand its evolving CCR program throughout the State. DNREC wants to create a means by which CCRs can log onto a web site and download their information directly into a DNREC database. Ultimately, this will enable the State to keep track of the work performed by the CCRs and also will provide a GIS data layer of State construction sites and inspection locations. The continued goal of the program is to improve the implementation of Sediment and Storm Water Plan compliance without relying on enforcement penalties to achieve program goals.

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Sources:
Natural Resource Defense Council, 1999
<www.dnrec.state.de.us/news21tx.html>

Storm Drain/Sewer Separation: A Case Study in Small Town Initiative

Successful Storm Water Control Elements Similar to Those Applied by Phase I Permittees:
- Eliminating sanitary cross-connections drastically reduces storm water sewer pollutant concentrations.

The city of Dover, New Hampshire, population 26,500, is one of the most urbanized municipalities in the New Hampshire coastal region. Although it is not a Phase I permittee, its experience with storm sewer management is typical of many Phase I communities.

Location:
Dover, NH

Area:
28.87 sq mi

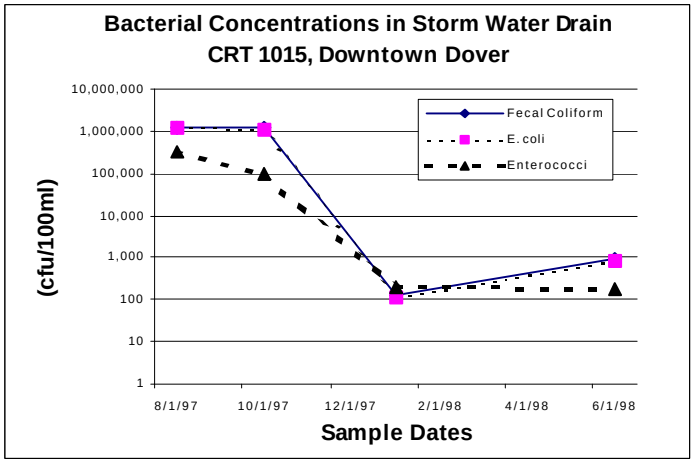
Affected Waters:
Bellamy, Chocheco, and Piscataqua Rivers

Dover is adjacent to New Hampshire's Great Bay Estuary and has numerous rivers, including the Bellamy, Chocheco, and Piscataqua rivers. A 1997 report published by the New Hampshire Department of Environmental Services (*An Investigation of Water Quality in New Hampshire Estuaries*) revealed that bacteria originating from storm drain/sanitary sewer cross-connections in downtown Dover were affecting the bay's water quality. Faced with this conclusion, the city of Dover took action to eliminate bacteria loads to the city's rivers through storm drain/sewer separation.

In a partnership with the New Hampshire Estuaries Project and the NHDES, Dover Community Services Department staff have worked to identify and eliminate storm drain/sanitary sewer cross-connections, focusing on the area that encompasses the downtown center of Dover and the Cochecho River. Begun in 1997, this ongoing project has involved water quality sampling, smoke testing, and other means to identify cross connections. Frequently, the best indicator of a cross-connection is elevated bacteria levels in dry-weather flows as illustrated in the monitoring results for a single sewer outfall (note the elevated bacteria levels between August and October, 1997 in the graph below). Dover discovered several storm drain outfalls with high levels of *E. coli* bacteria, which indicated a direct sewage discharge into the storm drain system.

Where needed, Dover Community Services has extended its work to investigate individual homes suspected of having a sewer connection to the storm drainage system. The city on average spends about $3,000 to eliminate a cross connection. Although the costs of eliminating cross-connections would be the responsibility of the property owner, to obtain timely and efficient resolution, the city of Dover has absorbed some of the management costs to ensure that the problem is addressed.

Dover's effort is preventing raw wastewater discharges from the storm sewer system that once flowed into the Cochecho River and eventually into the Great Bay Estuary. To date, monitoring results show declining bacteria counts in the river, although bay levels are still elevated. However, the magnitude of the post-management reduction at a storm drain outfall is demonstrated in the 99 percent decline in bacteria counts shown in the graph (as shown by bacteria levels after December, 1997). Other urban areas in the Great Bay watersheds have either documented or suspect cross-connections are their primary source for high levels of bacteria. By studying its storm water system and developing a storm water management plan, the city of Dover has shown itself to be a good a role model for other coastal New Hampshire communities.



Contact:
Dean Peschel, Environmental Projects Manager 603 743-6094
Source:
1999 National NPDES Program for Storm Water Control Excellence Awards Application

Fort Worth, Texas: Preventing Pollution by Managing Hazardous Household Wastes

Successful Elements Related to Phase I Program:

- Annually, 50,000 gallons of toxic liquid wastes are destroyed or recycled and kept out of the environment.
- Per year household waste drop-offs have increased 54 percent, and after only 2 years of collection center operation 3 percent of households have used the waste drop-off option.

Location:
Fort Worth, Texas and adjacent communities

Affected Area:
312,500 households (125,000 in Fort Worth)

To meet the requirements of its Phase I storm water permit, the city of Fort Worth, Texas, has moved aggressively to create convenient household waste disposal facilities and to remind its residents regularly of the opportunity for disposal and recycling. Working with other nearby communities, the Fort Worth Department of Environmental Management started by sponsoring a series of collection events. The first comprehensive household hazardous waste collection event in north-central Texas was held in Fort Worth on May 15 and 16, 1993. By the end of the event, more than 1,500 households had participated, dropping off thousands of pounds of waste. Encouraged by the response to the first event, Fort Worth continued to hold household waste drop off events for several years, noting a sustained level of public participation in such events. To better serve its citizens and to meet its Phase I permit obligations, Ft. Worth initiated an expanded household waste program, one that included a permanent and convenient drop off location.

The Environmental Collection Center (ECC) opened December 11, 1997. It is the largest drive-through household chemical waste drop-off center in Texas and the first in north-central Texas to be open year-round. The facility is located on 4 acres in eastern Fort Worth, close to neighboring cities. The city of Fort Worth uses a regional approach in preventing the improper disposal of household hazardous waste into the storm water system. The city has negotiated inter-local agreements with 19 customer cities, representing Tarrant, Dallas, and Erath counties. Many of the participating communities are not subject to the Phase I storm water regulations but will be regulated under the Phase II program. In total, approximately 1.25 million people (about 312,500 households) reside in the participating cities, and all are welcome to dispose of their household waste at the ECC.

As shown in the table at right and the figure below, both the household participation and waste collected have increased dramatically since the start of the household waste collection program in 1993. Hundreds of thousands of pounds of waste, much of it in liquid form, is now collected and destroyed. The Phase I storm water permit program started Fort Worth's pollution prevention efforts, which have kept tons of waste out of the city's storm water, landfills, and wastewater treatment plant.

Household Waste Collected by Environmental Collection Center (ECC)

Year	Total Number of Households Serviced	Waste Collected from All Participating Communities (Pounds)	Fort Worth Households Serviced	Fort Worth Waste Collected (Pounds)
1993	1,559	180,105	1,539	180,105
1997	6,011	222,000	(Unknown)	158,000
1998	9,249	266,558	4,190	185,172

Contact/Source:
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Information Availability, Education, and Enforcement—Successful Program Elements

Successful elements Related to Phase I Program:

- An effective education and awareness program for both permittees and the public.
- Incorporation of erosion and sediment control into the development site planning process.

Location:
Garland, Texas

Affected Area:
57 square miles miles

The city of Garland, Texas, started its erosion and sediment control program in 1993 in response to National Pollutant Discharge Elimination System permit requirements. One of the first steps was the publication of a construction best management practice (BMP) manual. Garland's erosion and sediment control (ESC) program requires BMPs on sites as small as 5,000 square feet and detailed site plans for all sites of 1 acre or larger. "Implementation of BMPs has definitely improved as a result of this program," says Philip Welsch, Garland's Storm Water Coordinator. "Erosion control on construction sites was basically nonexistent before that time." Eight to ten of the most prominent developers in the area were included in the development of the handbook and program, and this approach seems to have contributed to its acceptance in the community, according to Welsch.

Garland, in conjunction with seven other Dallas/Fort Worth area Phase I cities and the North Central Texas Council of Governments, also developed a training curriculum on the Construction General Permit requirements and local erosion and sediment control techniques. The city then turned the training responsibility over to Texas A & M University, and for a small fee developers and contractors can attend the training. Although Garland does not offer any type of formal incentive program, developers have discovered it is beneficial when trying to develop approvable site plans or to avoid stop-work orders. The training continues to be well attended.

Garland also has developed a comprehensive program to monitor developers and contractors and educate them about the ESC program. For all sites that will disturb more than 1 acre of land, the city requires a pre-construction meeting before development may begin. All erosion control requirements and resulting noncompliance enforcement measures are outlined at that time. In addition, all city inspectors are trained in erosion and sediment control. For single family homes, the site must pass an ESC inspection prior to being cleared for any other type of inspection, e.g. electrical, plumbing, framing, etc. Each commercial site is inspected once a month and the entire project can be stopped for an ESC violation. Although the enforcement component of the inspection program is critical, each inspection also represents contact between the inspection staff and a contractor. This therefore serves as an additional method to heighten awareness of the ESC program in the development community.

The city of Garland also committed to the addition of a full-time storm water public information specialist in its MS4 NPDES permit, and Welsch attributes much of the storm water program's success to the resulting public awareness and education program. Approximately 3,000–4,000 schoolchildren are taught about storm water and nonpoint source pollution each year. Welsch says, he has noticed an increase in calls to Garland's environmental hotline from children reporting their parents for noncompliance with the storm water regulations.

Contact:
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Source:
National Resources Defense Council, 1999

Urban Runoff Threatens Salmon Fishery; A Case Study in Management Initiatives

Important Elements:

- King County has documented the adverse effects of storm water runoff on salmon populations, and millions of dollars will be spent to restore habitat lost in urban areas.
- Storm water management measures are being developed to offset problems caused by existing urbanization and prevent problems from new development.

King County, Washington, a Phase I community, is one of the most populated counties in Washington State and is home to the cities of Seattle and Bellevue. For the county, the local environmental impacts of urbanization, related to greater storm water runoff and pollutants, were documented in the 1980s. In a 1984 study comparing the water quality of two creeks, the urban Kelsey Creek and the rural Bear Creek, the urban salmon population was found to be in significantly poorer health. The study found that high runoff flows originating from developed areas in the county scour and alter the shape of the stream channel, causing a reduction in habitat quality and dissolved oxygen levels. In addition, urban storm water discharge contains priority pollutants, organics, and heavy metals—pollutants that can be traced back to dirt and grime washed from streets during rainfall. The impacts of unmanaged storm waters on habitat and salmon populations is of increased importance since two of the region's native fish (bull trout and chinook salmon) were placed on the Federal list of threatened species in 1999.

Location:
King County, WA

Area:
2164.6 sq mi

Affected Waters:
Puget Sound and its tributaries

In 1995 King County received its NPDES Storm Water Permit. The Phase I program provided the county a template to address the multitude of issues surrounding storm water control. As the county's storm water program evolves, it is integrating with other environmental efforts focused on preventing new damage to stream habitat and restoring streams damaged by storm water. For example, King County has several public-oriented programs to change the behavior of homeowners and its all-volunteer "Stream Team" helps with stream protection. As a means of broadening public participation, the county has created a web site where citizens can log on and suggest ways to improve storm water quality.

Additionally, the county is now creating a forest cover requirement that requires a 65 percent retention for all new development. Retaining natural cover is an increasingly common BMP for minimizing runoff generation, and it is only one of several BMPs that will be standardized in King County to meet this objective. Within the priority Bear Creek watershed, where urban impacts on salmon were first documented in King County, the 65 percent forest retention requirement is already employed to help protect the salmon habitat and population. The intent is to prevent future problems such as those that have led to expensive stream restoration efforts (described below) intended to return stream habitat lost within King County.

In another effort to prevent pollutants that could affect water quality, in October 1999 the city of Seattle (located in King County) and King County announced a program to eliminate most of its hazardous pesticide use by June 2000. The goal is to reduce overall pesticide use on public lands managed by the city and county. According to King County Executive Ron Sims, "King County has made a concerted effort to reduce our use of pesticides. We've reduced our use to protect people, but now we will take the next step and be certain that we're protecting salmon and other species as well. This new policy will ensure that the parks, roadways, and open spaces that we maintain will be salmon-friendly. We will make the policies and guidelines available to other government agencies throughout our region."

King County recognizes the impacts of past urbanization and storm water runoff on stream habitat and the threatened fish population. As a result, an initiative is under way to create a $2.3 million fund for fish habitat restoration. Plans for specific projects are currently in development, but the basic plan is to restore stream habitat along 700 miles of urbanized streams, a major fraction of the county's 3,000 miles of streams.

King County's future focus is to continue developing management measures protective of its aquatic habitats and its threatened fisheries. Storm water management BMPs and program elements will be a major component of this effort, minimizing the occurrence of new water quality problems and helping to offset problems created through earlier urbanization. King County can draw on the storm water management experience/examples offered by numerous other Phase I permittees now establishing programs to restore and protect local waterways.

Contact:
James Schroeder, 206 296-8381
Program Analyst, King County

Sources:
<http://www.metrokc.gov/>
USEPA, 1992

Los Angeles County: Streamlining Monitoring in a Maturing Storm Water Program

Successful Elements Related to Phase I Program:

- As storm water pollutants are identified, a maturing program is streamlining its storm water monitoring to reduce costs and optimize program efficiency.
- A reduction in point-of-discharge monitoring is anticipated at locations where pollutants have been detected infrequently.

Phase I storm water monitoring helps indicate where pollutants contribute to a problem and what pollutants are of concern. Storm water quality varies with location because different upstream land areas contribute different types and amounts of pollutants. With many possible monitoring locations, it is important to streamline monitoring efforts to learn where and how storm water might affect receiving waterbodies.

Location:
Los Angeles County, California

Area:
3,100 square miles

Population:
9,757,500

Affected Waters:
Ballona Creek, Malibu Creek, Los Angeles River, Coyote Creek, and San Gabriel

Los Angeles County is currently streamlining its Phase I storm water monitoring to reduce costs and optimize fund usage. When its storm water monitoring demonstrates a pollutant is not present at a particular location, Los Angeles intends to stop monitoring for that particular pollutant at that location. Having concluded that an anticipated storm water pollutant is, in fact, not present at levels of concern, Los Angeles will spend its monitoring dollars on other locations where storm water might be of poorer quality.

The storm water monitoring efforts demonstrate the characteristics common to Phase I permit holders. As a monitoring program matures, it evolves from the initial storm water quality characterization to assessment of best management practice (BMP) effectiveness. Then it focuses on specific water quality problems caused by storm water (Table 1). The *Water Quality Assessment for Los Angeles County* (1996) states that the main pollutants found to cause water quality impairments are certain heavy metals, coliform, enteric viruses, pesticides, nutrients, polycyclic aromatic hydrocarbons, trash, debris, algae, scum, sediments, and odor. With this understanding, Los Angeles County is now proposing to discontinue monitoring where these pollutants have not been found to pose a threat, using the time and money to monitor elsewhere. As the monitoring program matures, sufficient data will be available to focus on where and which storm water pollutants are causing water quality problems. Table 2 shows Los Angeles monitoring locations and indicates which specific storm water pollutants are sufficiently characterized to allow discontinuation of monitoring at that location.

Table 1. Phase I Storm Water Monitoring Overview

Period	Storm Water Monitoring Objectives
1990-1995	Characterize the storm water quality and quantity in various locations and for various land use types
1996-Current	Expand the monitoring program to incorporate evaluation of BMPs through pilot studies

Contact:
Bill DePoto, L.A. County Public Works Storm Water Quality Section
626 458-3537

Source:
< www.888cleanla.com>.

Notes:
x = constituent that meets the criterion of less than 25% detection in 10 consecutive samples

d and t = dissolved and total

d only = dissolved only

empty cell = not enough data to analyze

Table 2. Station-Constituent Combinations Recommended for Discontinuation of Monitoring

	Station				
Analyte	**Ballona Creek**	**Malibu Creek**	**Los Angeles River**	**Coyote Creek**	**San Gabriel**
Conventionals					
Cyanide	x	x			
TPH		x	x		
Total Phenols	x	x			x
Metals					
Aluminum		d only			
Antimony	d and t	d and t	d and t	d and t	d and t
Arsenic	d and t	d and t	d and t	d and t	d and t
Beryllium	d and t	d and t		d and t	d and t
Cadmium	d and t	d and t		d and t	d and t
Chromium	d and t	d and t		d and t	d and t
Chromium +6	d and t	d and t	d and t	d and t	d and t
Copper		d and t			
Lead	d and t	d and t		d and t	d and t
Manganese	d and t	d and t		d only	d only
Mercury	d and t	d and t	d and t	d and t	d and t
Nickel	d and t	d and t		d and t	d and t
Selenium	d and t	d and t	d and t	d and t	d and t
Silver	d and t	d and t	d and t	d and t	d and t
Thallium	d and t	d and t	d and t	d and t	d and t
Pesticides					
All Pesticides		x	x	x	x
Chloradane	x	x	x	x	x
N-Pesticides	x	x	x	x	x

Lake Harriet: A Public Outreach Success Story

Successful Elements Similar to Those in the Phase I Program:

- The city of Minneapolis created the widely supported Lawn Care Program to address water quality problems from storm water.
- Lake Harriet has undergone a reduction in pesticide pollutant levels by 60 percent since the Lawn Care Program started.
- The environmental benefits are enjoyed by the estimated 2.4 million people who visit Lake Harriet each year.

Location:
Minneapolis, Minnesota

Affected Area:
Lake Harriet

Number of People Served by Permit:
368,384

Lake Harriet is located within the city limits of Minneapolis, a city whose Phase I storm water program is under development. The lake covers 300 acres and is fed by a watershed containing about 6,000 homeowners. In the early 1990s the poor water quality in Lake Harriet was obvious to both visitors and the residents of the watershed. Minneapolis began a comprehensive study of Lake Harriet to identify the pollutants entering the lake. Storm water monitoring helped to identify that the majority of the pollutants came from local homeowners' lawn care practices. As a result of the study's conclusions, an intensive outreach program was started. The Minnesota Pollution Control Agency contributed two grants to support storm water program development. The project goals were (1) to increase public awareness of the connection between lawn care practices and the protection of water quality and (2) to encourage lawn care practices protective of lake water quality.

Leading the outreach program were the Minneapolis Parks & Recreation Board, the Minnesota Department of Agriculture, and the Hennepin County branch of the University of Minnesota Extension Service. These organizations developed a hands-on outreach program using master gardeners, direct mailing of information packets, and newspaper publications. The master gardeners contributed more than 1,200 hours of volunteer time in training, water quality data collection, distribution of information packages, and general project assistance during the life of the Lake Harriet project.

As a result of outreach efforts, a 30 percent change in lawn-care behavior was recorded. By 1995 this change in behavior, surveyed over time, had also resulted in a significant 50 percent reduction of pesticide. During the 1995 growing season, only 22.3 grams (less than 1 ounce) of lawn weed pesticides entered Lake Harriet via the monitored storm sewer. The outreach program has decreased pesticide inputs into Lake Harriet by an average of 60 percent (see table). According to Gene Hugoson of the Minnesota Department of Agriculture, "Lake Harriet homeowners are to be commended for their efforts to improve water quality." Building on the success, the city of Minneapolis has chosen to expand the outreach effort to the other watersheds within the city limits.

Minneapolis's Phase I permit process is under way. As its storm water control efforts expand under Phase I, Minneapolis can build on the success of the Lawn Care Program to help ensure its storm water is not adversely affecting its waterways.

Water Quality Monitoring Results, Showing Pesticide Reductions

Pesticide	Annual Event Mean Concentration (ugL)				Percent Decrease
	1992	1993	1994	1995	1992-1995
Dicamba	0.5	0.4	0.2	0.2	59%
2,4-D	1.5	1.6	0.6	0.6	58%
MCPP	1.1	1.2	0.8	0.5	56%
MCPA	2.4	1.4	0.7	0.3	86%

Source: NRDC, 1999.

Contact:
Deb Pilger, Parks and Recreation Department,
Minneapolis, MN
612 370-4900

Sources:
<www.extension.umn.edu/distribution/naturalresources/DD6648.html>
Natural Resources Defense Council, 1999

Montgomery County: Biomonitoring Helps Measure Storm Water Management Success

***Successful Elements Related to Phase I Program*:**

- A 5-year commitment to biomonitoring is already providing crucial storm water management information
- Three designated *Special Protection Areas* have been established to protect high priority streams.
- BMPs have kept a significant portion of sediment and nitrogen from entering streams. The County has estimated that in 1998 23 percent of the sediment load and 27 percent of the nitrogen load was prevented from entering streams because of stormwater BMPs.

Montgomery County, in the Washington, DC, area has experienced rapid growth and development, accommodating a surge in population that started in the 1940s. In the past, extensive clearing of forests and conversion of agricultural land to residential and commercial development led to excessive soil erosion, nutrient loading, and hydraulic alteration of streams. Montgomery County recognized early that biomonitoring under its Phase I storm water permit could serve as a true indicator of water quality conditions. The quantity and species diversity of insects and fish in streams, along with habitat conditions, indicate the overall health of the streams more throughly than chemical quality measurements alone. Accordingly, Montgomery County is serving as a national example of how to design and conduct comprehensive biological monitoring to measure and track stream conditions. In 2001 the County will complete a 5-year biological monitoring plan that will measure biological conditions in all 1,500 stream miles in the County.

Location:
Montgomery County, MD

Area:
497 square miles
1,500 stream miles

Population: 846,000

***Affected Waters*:**
Potomac River
Patuxent River
Anacostia River
Monocacy River

Biological monitoring in conjunction with a state-of-the-art geographic information system (GIS) has helped the County map, assess, and rank each of the 22 subwatersheds in the County. The land use assessment and maps are presented in the Countywide Stream Protection Strategy, which is provided on the County's web site at http://www.co.mo.md.us/dep/Watersheds/csps/csps.html . This interactive report helps to explain the County's monitoring effort and program results. Stream erosion and sedimentation were the dominant impacts on habitat conditions and aquatic life found in Montgomery County's streams. These impacts originate primarily from uncontrolled or inadequately controlled storm water from developed areas, which significantly altered natural stream flows. In addition, inadequate control of sediment from construction sites has also caused problem "hot spots." The monitoring and GIS have helped the County develop a set of management tools to address the stream conditions and levels of development anticipated. The management categories and tools provide a basis for targeting interagency resources to address stream quality problems, using a focused, watershed-based approach.

The County has estimated that in 1998 23 percent of the sediment load and 27 percent of the nitrogen load was prevented from entering streams because of stormwater BMPs. Annual assessments show that total delivered loads increased slightly between 1997 and 1998 because no BMP can totally control the increase of pollutants associated with the increased imperviousness as an area is developed. However, based on the successes reported in the Countywide Stream Protection Strategy, the County has increased its 6-year budget for building storm water BMPs and restoring stream habitats from $15 million to $20 million. In addition, the County has committed more than $13 million since 1996 to purchase 350 areas of stream buffers to protect stream conditions. Approximately $17 million will be expended to purchase stream buffers.

Three designated Special Protection Areas (SPAs) in the County receive additional protection from storm water impacts. These areas were selected because of the high-quality stream conditions. New development planned within each of these areas is required to measure pre-development water quality and stream conditions as well as to monitor during and after

construction. New County regulations protecting streams in these SPAs from construction and storm water impacts were implemented in 1996. Additional monitoring over time will be needed to evaluate the effectiveness of the BMPs in these SPAs.

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Monterey Bay: An Effective Small City Monitoring Program

Successful Elements Relate to Phase I Program:

- Phase I serves as a template for effective storm water monitoring for small communities.
- Outreach focusing on restaurant owners has reduced pollution in storm water.
- Volunteers contribute to crucial water monitoring efforts.

The Monterey Bay National Marine Sanctuary in California is one of the most diverse marine environments in the United States. The sanctuary is a popular destination for divers, and the coastline continues to attract residential and light industrial development. Because of the impending NPDES Phase II storm water program and increased impervious surface area throughout the Monterey Bay region, the city of Monterey created an approach similar to the NPDES Phase I program to address its storm water issues. The city of Monterey is currently working with the city of Santa Cruz, Monterey Bay National Marine Sanctuary, California Coastal Commission, Association of Monterey Bay Governments, and a consulting firm to develop a Model Urban Runoff Program designed for small municipalities (under 100,000 in population). This program is funded by grants from the Clean Water Act Section 319(h) program. The program uses the "Urban Watch" monitoring method associated with the Phase I dry-weather sampling program of Fort Worth, Texas. The program also incorporates the six minimum control measures for the NPDES Phase II storm water program to form a comprehensive, consistent program. One of the six control measures under the Phase II storm water permit program is detection and elimination of illicit discharges.

Location:
Monterey, California

Area:
7.6 square miles

Affected Area:
Monterey Bay National Marine Sanctuary

The program incorporates nine trained volunteers for the collection of dry-weather water samples at four priority storm water outfalls. The dry-weather monitoring period is from June through October. The volunteers contribute, on average, an estimated 1,500 hours a year to monitor for dry-weather discharges. The volunteers work on a 12- to 14-day schedule, collecting two samples from a site within a 24-hour period (NRDC, 1999). The monitoring information gathered by the volunteers can help to pinpoint areas of environmental threats.

An example of the successful volunteer monitoring program is related to data that showed an increased amount of detergents, oily sheens, odors, trash, and surface scum coming from the area's local restaurants. These pollutants were determined to be entering the city's storm drains when restaurant staff washed off kitchen mats and other kitchen items. This information provided city officials an area on which to focus their outreach efforts. As a result, there was a recorded change in restaurant staff behavior that produced a reduction in the amount of pollutants entering the water. In conjunction with this environmental benefit, the volunteer monitoring program has saved the city of Monterey a considerable amount of money (see box).

Savings Realized from Urban Watch Program

The city of Monterey has saved an estimated $30,000 to $40,000 in monitoring costs by relying on volunteers.

The cost of volunteer training, monitoring and analysis, data analysis, presentations, and program administration is around $8,000 plus an additional $500 for startup equipment.

Contact:
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831 426-9012

Jennifer Hays, Assistant Civil Engineer, Monterey,
(831) 646-3920

Sources:
Natural Resource Defense Council, 1999
<www.monterey.org/water/wtrmgmt.html>

Enhancing North Carolina's Existing Sediment and Erosion Control Programs Through NPDES Construction Storm Water Program

Successful Elements:

- Enforcement and compliance tools to strengthen existing State sediment and erosion control program.
- Leveraged with other water quality protection programs, provides more comprehensive environmental protection.
- Goes beyond control of sediment in storm water runoff at construction sites.
- Enhances use of low cost pollution prevention activities.

Sediment and erosion control have been under way in North Carolina at the State and local levels since long before the advent of the Phase I NPDES Storm Water Construction program. So isn't the Phase I Program an unnecessary layer of construction storm water requirements? Not according to the North Carolina Department of Environment and Natural Resources (NCDENR), which has had a sediment control program in place since 1973. Recent enforcement actions against developers in North Carolina illustrate how the Phase I program enhances the State's existing Sediment Control Program to create a comprehensive and effective water quality protection program.

Location:
Brunswick County, North Carolina

Area:
856 square miles

Waters Affected:
Cape Fear River

In North Carolina, sedimentation is the largest water pollutant by volume. The State requires effective erosion and sediment controls to prevent inhibition of plant growth, disruption of fish nests, and the introduction of toxic substances into the water. An NCDENR report entitled *Crabtree Creek Watershed Earth Day Initiative for Sedimentation Control, May, 1998* highlights the rationale for and importance of controlling storm water runoff from construction sites. Points raised in this report are provided in the box below.

Within NCDENR, the Division of Land Resources (DLR) is responsible for administering the Sedimentation Control Program and the Division of Water Quality (DWQ) is responsible for administering the NPDES Construction Storm Water Program. The North Carolina Sedimentation Control Program regulates construction activities equal to or greater than 1 acre, more restrictive than the Phase I program which addresses only sites equal to or greater than 5 acres. Under the Sedimentation Control Program, construction site operators must develop and submit an erosion control plan and submit it to the DLR. When DLR approves erosion control plans for construction sites greater than 5 acres, it sends the construction site operator a copy of North Carolina's NPDES construction general permit in addition to an approval letter.

Points Raised in the Crabtree Creek Watershed Report

- As a community grows, development begins to encroach on the more environmentally sensitive or critical areas once the more desirable sites are occupied. Increased property values that usually accompany such growth tend to encourage overbuilding, resulting in tougher erosion and sedimentation problems and a potential for serious damage.
- When sedimentation damage occurs, it fills streams and lakes, increasing the potential for and frequency of flooding, the costs associated with water treatment and power generation, and the destruction of wildlife habitats. Harmful chemicals and other pollutants are often transported to waters in the soils deposited as a result of accelerated erosion and sedimentation.
- Erosion and sedimentation damage impacts land resources and quality of life, removing productive topsoil that cannot be replaced for generations and ultimately reducing property values. It also reduces the attractiveness of North Carolina for its citizens and visitors.
- Erosion often increases the cost of construction by requiring regrading of gullies and unplugging of storm

Although NCDENR staff admit that coordinating the two programs isn't always easy, they acknowledge that having the Phase I program in conjunction with the State Sedimentation Control Program is ultimately beneficial. The Phase I program has helped to open the lines of communication between DWQ and DLR. According to Joanne Steenhuis of DWQ, "Historically the Departments of Water Quality and Land Resources have had limited interaction, despite the fact the departments have similar goals regarding construction site runoff control. The construction general permit required under the Phase I program has been a mechanism to bring different environmental programs together."

In addition to improving communications within the NCDENR, the Phase I Construction Storm Water Program also provides a stronger incentive for compliance with both programs. Penalties assessed

under the Sedimentation Control Program are $5,000 per violation per day, whereas penalties under Phase I can be as high as $25,000 per violation per day. The two departments recently joined forces to stop poorly managed construction activities in a portion of Brunswick County, North Carolina. Ditching activities had resulted in the improper drainage of nearly 1,500 acres of wetlands. Through inspections, DLR and DWA determined that the developers had not prevented off-site sedimentation from ditching activities. As a result, the ditching activities not only had resulted in a loss of wetlands but also had caused exceedances of the turbidity standard in Beaverdam Creek, a designated primary nursery area classified as high quality waters. A settlement reached between DWQ, DLR, and the developers included the restoration of the drained wetlands and $213,000 in fines and enforcement costs.

The Brunswick County situation in North Carolina illustrates how the Phase I program is an important component of an overall suite of water quality protection programs. In this situation, the Phase I requirements not only played a key role in controlling sediment-laden runoff, but also assisted in the restoration and protection of valuable wetland resources. "The construction general permits we issue under the Phase I construction program are an important piece to a comprehensive construction storm water control program," states Bradley Bennett, the supervisor of the storm water unit within DWQ. "The Sedimentation Control Program focuses on the primary pollutant from construction sites, but does not address the other possible pollutants that could originate from construction equipment and other activities on site. Under the provisions of the construction general permit, construction site operators must also think about good housekeeping practices to prevent contaminating runoff with fuels, lubricants, pesticides, and other related materials."

North Carolina is committed to effectively addressing its water quality problems related to sedimentation and erosion. In 1997 Governor Hunt proposed $2.1 million for inspectors as a way to expand and enhance the State sediment control program requirements, increase technical training and assistance, and strengthen enforcement practices. Due to the interconnectedness of the State sediment control program, the effectiveness of the Phase I program is likely to increase.

Contact:
Bradley Bennett
Storm Water Unit, NPDES Unit
North Carolina Department of Environment and Natural Resources
919 733-5083

Sources:
Sedimentation Sweep Uncovers 79 Problem Sites, NCDENR, May 1998
Brunswick County Developers Agree to Restore 1,500 acres, Pay $213,000 in Fines and Enforcement Costs, NCDENR, December, 28, 1999

Detecting and Eliminating Improper or Illegal Connections and Discharges in Palo Alto, California

Successful Elements for the Phase I Program:

- Positive incentives, regular inspections, and helpful outreach are the key elements of Palo Alto's efforts to reduce storm water contaminant loadings from vehicle service facilities.
- From 1993 to 1996 storm water discharge quality improved: average copper concentrations dropped 89 percent, average lead concentrations dropped 96 percent, average nickel concentrations decreased by 93 percent, and average zinc levels dropped 77 percent.

As part of the effort to reduce pollution from vehicle service facilities, Palo Alto's Regional Water Quality Control Plant (RWQCP) developed a Clean Bay Business Program to recognize vehicle service facilities that proactively reduce the discharge of pollutants to sewers and storm drains. The sewer-use ordinance applicable to the plant's service area prescribes 15 best management practices (BMPs) to control flow into the plant's wastewater and storm water systems. Some of the required storm water BMPs include eliminating discharges or disposal to storm drains, performing oil changes and other vehicle fluid removal over secondary containment, immediate cleanup of spills using non-water-using procedures, containment of leaking fluids, containment of wastewater from vehicle washing, annual employee training, and stenciling of storm drains.

Location:
Palo Alto, California

Number of People Served by Permit:
236,000 (service area)

Affected Area:
24 square miles (city)

The combination of ordinance requirements and annual inspection visits has resulted in dramatic behavioral changes at vehicle service facilities. In 1992 only 4 percent of the 318 facilities inspected complied with all 15 requirements. In 1998 inspectors found 94 percent of 289 facilities to be in compliance after the first or follow-up inspection. Facilities eliminated 78 direct discharges to storm drains by ceasing or modifying vehicle washing activities, ending parking lot cleaning and outdoor wet standing of vehicles, and making other changes. Violations of requirements that protect storm drains fell by 90 percent from 1992 through 1995.

Since 1992 average metal concentrations in storm water discharges from vehicle service facilities have dropped considerably. Average copper concentrations are down 89 percent to 0.32 mg/L (compared to a local limit of 2.00 mg/L established by Palo Alto under EPA pretreatment regulations). Lead levels are down 96 percent to 0.14 mg/L (local limit of 0.50 mg/L). Nickel concentrations have decreased by 93 percent to 0.07 mg/L (local limit of 0.50 mg/L). And zinc levels are down 77 percent from the high in 1993 to 1.55 mg/L and are below the local limit (2.00 mg/L). In 1996 average discharge concentrations from permitted facilities were a fraction of the local limits for all heavy metals, except zinc. Zinc concentrations increased in 1995 and 1996 as a result of more auto body shops and fleet operations receiving permits for vehicle washing activities. The sample results revealed two facilities with significant discharges of zinc (an order of magnitude above the local limit).

Average Metal Concentrations from Permitted Vehicle Service Facilities

Parameter	1993 (mg/L)	1994 (mg/L)	1995 (mg/L)	1996 (mg/L)	Local Limit (mg/L)
Copper	2.98	0.36	0.57	0.32	2.00
Lead	3.74	0.29	0.32	0.14	0.50
Nickel	1.07	0.08	0.12	0.07	0.50
Zinc	6.69	0.91	1.27	1.55	2.00

Source: City of Palo Alto web page:
http://www.city.palo-alto.ca.us/cleanbay/autoprog.pdf

The significant decrease recorded from 1993 to 1996 is a direct result of Palo Alto's pollution prevention efforts and increased maintenance of treatment systems. The city's continued storm water management efforts have received national recognition through six storm water awards since 1996.

Contact:
Ken Torke, Associate Engineer, Regional Water Quality Control Plant, 650-329-2421

Sources:
Natural Resources Defense Council, 1999
City of Palo Alto web page:
http://www.city.palo-alto.ca.us/cleanbay/publications.html

Preserving A Community's Quality of Life Using the NPDES Construction Storm Water Program

Successful Elements:
- Minimizes threat to economically important wetlands and fish habitat by ensuring responsible development practices.
- Successful implementation of the construction storm water pollution prevention plan reduces violations of water quality standard for turbidity.

The siting and development of the Stafford Creek Corrections Center in Grays Harbor County, Washington, did not come about without controversy. The mixed emotions from County residents stemmed of conflict between the desire for economic development and the concerns about degrading the Grays Harbor Estuary, a waterbody currently listed as impaired on EPA's 303(d) list of impaired waters. Construction of the facility requires disturbing approximately 210 acres along Stafford Creek, a tributary of the Grays Harbor Estuary that drains 1,100 acres and contains valuable salmon and oyster habitat as well as wetland resources. Although local supporters of the facility recognized the potential negative impacts on the aquaculture industry derived from the Grays Harbor Estuary, they felt it was important to find a way to bring at least 650 additional jobs into the area.

Location:
Grays Harbor County, Washington

Area:
1918 square miles

Affected Waters:
Stafford Creek and other tributaries of the Grays Harbor

Federal, State, and local stakeholders involved in the Stafford Creek Corrections Center proposal worked together to see that both economic development and environmental protection in Grays Harbor County would be possible. The storm water construction permit, as required by the Phase I program, provided a mechanism to ensure that the development of the facility would not threaten the nearby wetlands and salmon habitat of Stafford Creek and other surrounding water bodies. The most important requirement of this permit is the development and implementation of a storm water pollution prevention plan (SWPPP). Although the Washington Department of Ecology does not typically review and approve SWPPPs, it can request to review a SWPPP for projects that may pose a significant water quality concern. The Department of Ecology worked with the Department of Corrections (DOC) for nearly 18 months to develop a SWPPP that would, when implemented, successfully control sediment-laden runoff from the construction site.

A SWPPP for construction activities, according to the *Guidance Document for Applying for Ecology's General Permit to Discharge Stormwater Associated with Construction Activity*, must be implemented when soil-disturbing activity commences and must be updated and maintained throughout the entire life of the construction project. Components of an SWPPP include an erosion and sediment control (ESC) plan and a spill prevention and emergency cleanup plan. The ESC plan is the focus of the SWPPP. It must describe stabilization best management practices (BMPs) and structural BMPs intended to divert flows from exposed soils, store flows, or otherwise limit runoff and pollutants from exposed areas of the site. The Department of Ecology finally issued DOC a construction storm water permit based on the strength of the SWPPP, which contained additional protective measures, including the following:

- Terminate all construction activities for the winter by October, in accordance with the *Puget Sound Storm Water Manual*.
- Conduct daily sampling and monitoring around the site to determine if there are exceedances of the turbidity water quality standard (5 Ntu).
- Provide the Department of Ecology with a written report documenting exceedances within 5 days of detection.
- Stop work if an exceedance is detected,and do not resume work until the problem has been identified and corrected.

Without implementation, an SWPPP is nothing but a document. It is effective only if properly implemented, continually assessed, and appropriately modified to improve BMP performance. Under the Phase I program, development and implementation of an SWPPP are enforceable permit conditions. In the case of DOC, it demonstrated partial compliance with its permit by developing an SWPPP. However, DOC violated its permit, thereby breaking its commitment to the protection of Grays Harbor Estuary, when it failed to implement all of the conditions contained in its SWPPP.

Construction of the Stafford Creek Corrections Center began in June 1998, and storm water runoff problems started with Washington's rainy season in the fall. Beginning in October 1998, DOC reported exceedances of the turbidity water quality standard. Inspections conducted by the Department of Ecology between November 1998 and February 1999 revealed that DOC was not fully implementing its SWPPP. Construction activities had continued beyond October and into the winter to meet the scheduled opening date of the facility. Some of the BMPs described in the SWPPP either were not in place on-site or were not receiving proper maintenance. As a result of improper storm water control activities, a slope

failure occurred that covered 0.2 of an acre of nearby wetlands. Monitoring and reporting during this period, conducted by both DOC and local college students, illustrated both the frequency and magnitude of violations. By February 1999, DOC had reported 62 violations in varying degrees. Subsequently, the Department of Ecology issued an order and penalty due to permit violation and State water quality standards.

DOC invested a significant amount of time and money into addressing problems on its site and implementing its SWPPP. "DOC claims to have invested approximately $850,000 into cleaning up the site and implementing their BMPs. Although I can't say for sure, DOC may not have had to spend that amount on storm water controls and site cleanup if they had implemented their SWPPP at the outset of the construction project," stated Janet Boyd, the Department of Ecology enforcement officer and inspector working on the Stafford Creek Corrections Facility site. According to monitoring and reporting data, DOC's investment paid off in improved storm water quality. As shown in the table at left, DOC reported more than 10 exceedances each month to the Department of Ecology between November 1998 and February 1999. DOC did not report any exceedances between March and April, 1999, once construction workers had fully implemented the SWPPP and addressed problems on-site.

Monthly Exceedances of the Water Quality Standard for Turbidity Reported to the Washington Department of Ecology by the Washington Department of Corrections

Month (1998 - 1999)	Number of Exceedances Reported
November	14
December	15
January	11
February	22
March (SWPPP fully implemented and turbidity problems addressed)	0
April	0

Ecology fined DOC $44,000 for violations of its storm water permit. "The Stafford Creek Corrections Facility has been a challenge, and the local creeks have probably suffered as a result of the lack of adequate sediment and erosion controls at this site," admits Janet Boyd. "But I would hate to think what the site might have been like if DOC did not take responsibility for their actions, or if Ecology didn't have the ability through the NPDES Storm Water Program to inspect the site, provide technical assistance, and exact fines to bring DOC into compliance."

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Sources:
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Prince George's County: GIS Helps Evaluate Load Reductions and LID Promises Problem Avoidance

***Successful Elements*:**

- GIS helps to target watersheds for restoration and provide support for restoration efforts.
- Modeling tools developed under Phase I storm water permit provide better estimates of pollutant loads.
- Low-Impact Development techniques provide localized, tailored BMPs to control storm water runoff.

Prince George's County, Maryland, is located in the Washington, DC, metropolitan area and shares the Anacostia River with the District. The Anacostia is a mature, highly urbanized river with many of the problems typical of urbanization—pollution, economic stagnation, and long-term degradation. This river has often been considered the Washington, DC, metropolitan area's "forgotten" river. The Anacostia River watershed has become the site of one of the first large-scale watershed restoration activities in the Nation. Communities and organizations all along the river have become engaged in efforts to enhance its environmental quality, rebuild its economic vitality, and reconnect the people to the river.

Location:
Prince George's County, MD

Area:
488 square miles

***Population*:**
792,030

Affected Waters:
Potomac River

Prince George's County has been recognized as a leader nationally in watershed management. Key factors to the success in the past have been the commitment of County staff and the development and delivery of assessment tools including, GIS data, models, and technical support. Prince George's County has developed a GIS primarily under the Stormwater Phase I program that not only supports the County's planning and management activities but also is designed for use by the public in conducting daily business with the County. The GIS and related models have received national awards such as the 1993 Public Technology, Inc., Special Mention Award in the Environmental Services category; the 1995 Urban and Regional Information Systems Association Exemplary System in Government Award; and the 1996 National Association of Counties Achievement Award in the Information Technology category.

GIS applications that have been developed under the stormwater program include the following:

- ***Geo-Storm: GIS-Based Hydrology and Hydraulic Analysis.*** Using this model users can compute runoff from watershed units, route through reach and reservoir networks, and analyze river hydraulics.

- ***Watershed Planning System (WPS):*** A GIS-based water quality modeling system, WPS was developed to support the County's initiatives in evaluating water quality conditions, perform preliminary prioritization and targeting of watersheds, and develop planning-level watershed management plans by integrating the EPA-supported Storm Water Management Model (SWMM) with the County GIS. The Commercial and Industrial module includes several utilities designed to assist in management of storm water from commercial and industrial facilities; to retrieve and display facilities based on their location, SIC code, address, and watershed; and thereby to develop targeted pollution prevention plans.

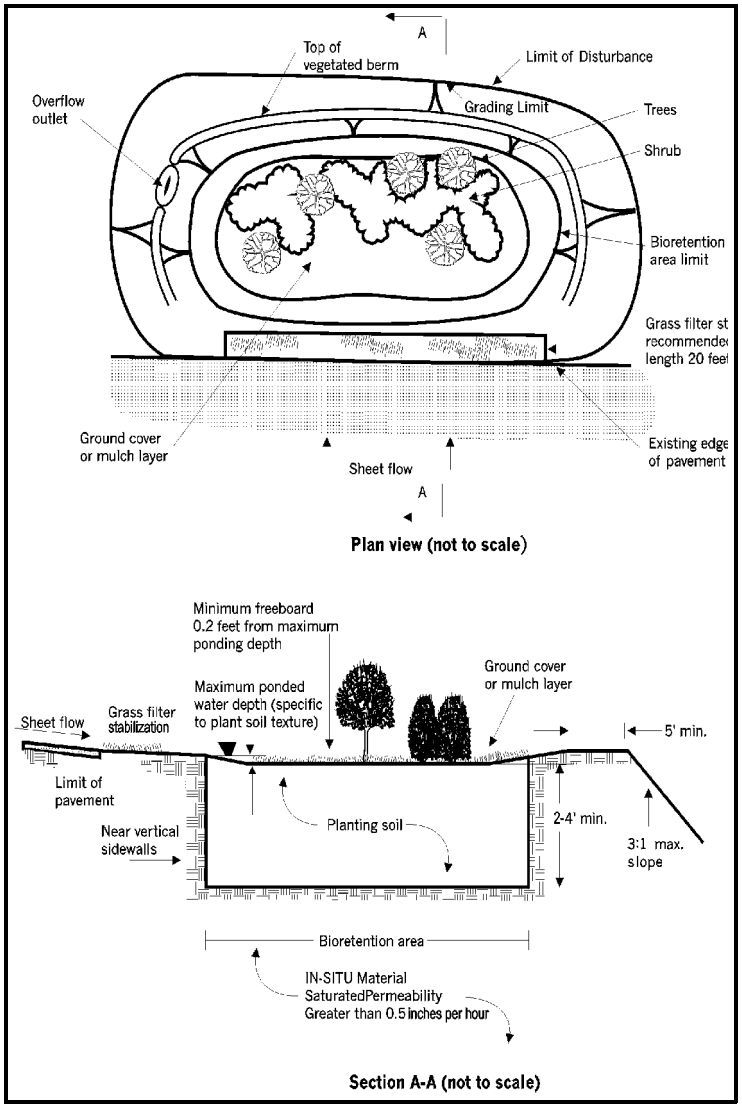
- ***Hydrological Simulation Program-Fortran (HSPF):*** The County's water quality module simulates continuously the hydrology and associated water quality pollutant loadings.

- ***On-Site Septic GIS-Based System Assessment:*** SEPTIC is a software package that includes a pollutant fate and transport model integrated with the GIS to evaluate the long-term impacts of nitrogen loading from septic systems in non-sewered areas of the County. The system allows users to easily set up a management scenario and view the impact on surface water as derived by the model.

- ***Public Storm-Drain***: The Storm Drain Inventory offers enhanced visual capabilities to locate any public storm drain pipe in Prince George's County. The inventory of pipes, inlets, and manholes is depicted geographically for the public to query by location and/or permit number. This inventory is a valuable tool for developers, engineers, and the members of the public who have the need to know the location of existing infrastructure for possible extension of new lines or connection to existing ones.

Prince George's County has recognized that traditional storm water management has its limitations. The traditional approach results in the creation of an extremely efficient storm water runoff conveyance system. Every feature of a development site is carefully designed to quickly convey runoff to a centrally located management device. As a result, the magnitude of hydrologic changes is amplified as natural storage is lost, the amount of impervious surface is increased, and runoff travel times are decreased. Prince George's County has led in the development of a new site design process to control storm water runoff, Low-Impact Development (LID). The principal goal of LID is to ensure maximum protection of the ecological integrity of the streams by maintaining the watershed's hydrologic regime. LID allows the site

planner/developer to use a wide array of simple, cost-effective techniques that focus on site-level hydrologic control. With support from EPA, the County has developed a national LID manual to help explain the concepts and applications to other areas of the country so that storm water impacts can be minimized.



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Portland, Oregon: Redirecting a Storm Water Policy

Successful Elements Related to Phase I Program:

• Compliance with storm water pollution control plans has more than doubled from 41 percent to 87 percent. Portland has estimated reductions in pollution discharges due to its Phase I program for four source categories—illicit connections, washwater discharges, accidental spills, and erosion/sedimentation problems.

Portland's Phase I storm water permit resulted in a significant change in the city's storm water program, once focused only on flood prevention. Responding to the Phase I requirements, Portland redirected its storm water policy to emphasize citizen involvement, water quality partnerships, and environmental leadership. A key component of its program is identifying and eliminating illicit connections and discharges. Portland's Illicit Discharge Elimination Program (IDEP) currently monitors between 90 and 100 storm water priority outfalls for illicit dry-weather discharges. The more sensitive the receiving water or the greater the potential for polluted discharge, the more frequent the monitoring. When an illicit discharge is detected, additional monitoring and tracking are performed to pinpoint the source. Information on sources identified is forwarded to experts in the city, who then work with the dischargers to end the illicit discharges to the storm sewer system.

Location:
Portland, Oregon

Area:
3,743 square miles

Population:
1,700,000

Through its Industrial Education and Permitting Program (IEPP), Portland has also established internal and regional pollution prevention outreach teams to provide technical assistance to the city's permitted industries, as well as an incentive program to reward environmental achievements by industries. Portland's efforts have greatly increased performance: industrial compliance with storm water requirements has jumped from 41 to 87 percent and violations are now found in 23 percent of inspections, down from 30 percent. The city of Portland has also sought to prevent improper discharges from all of its bureaus (e.g., Water and Fire Departments, Park Bureau). Guided by the Bureau of Environmental Services, the city has implemented BMPs at the Fire Department's training facilities to prevent pollutant generation and migration. The city's Park Bureau has developed dechlorination procedures for maintenance operations at the city's public pools. The chlorinated water of public pools is often a source of dry-weather discharge pollution, and dechlorinating the water eliminates a potential threat to storm water quality and local fisheries. Portland has estimated reductions in pollution discharges due to its Phase I program for four source categories—illicit connections, washwater discharges, accidental spills, and erosion/sedimentation problems.

A survey of businesses and citizens in the city indicates an increasing understanding and knowledge of storm water quality and a willingness to change behavior to protect water quality. Additional accomplishments since the start of the Phase I program include the planting of more than 22,000 trees within the city limits. More than 500 property owners have voluntarily disconnected their downspouts from their roof drains to divert the water onto the lawns instead of to storm drains. With 60 percent voter approval, Portland has established a $135.6 million bond measure to acquire up to 6,000 acres of land to better manage sensitive watersheds and protect urban waterways. In addition, Portland has adopted more stringent regulations on development aimed at protecting floodplains and establishing erosion and sediment controls for all development.

Estimated Annual Loads Removed by IDEP (for the Year 1996)

Illicit Sanitary Connections	Washwater Discharges	Accidental Spills	Erosion/ Sediment Control
Total Suspended Solids - 250 lb	TSS - 100 lb	Diesel Fuel 400 lb	TSS - 1,630 lb
Biological Oxygen Demand - 250 lb	BOD - 80 lb		
Total Nitrogen - 40 lb	Total oil and grease - 4 lb		
Total Phosphorus - 10 lb	Copper -0.04 lb		
	Lead - 0.01lb		
	Zinc - 0.14 lb		

Portland maintains that it is difficult to fully quantify a pollutant reduction from the IDEP and IEPP and to assess water quality improvements. But it believes it is on the right path toward making a difference in the area's water quality.

Targeting and Managing Pollutants in Sacramento: A

Case Study of Phase I Management Options

Successful Elements of Phase I Program:
- Phase I monitoring helps identify and target management options.
- Judging storm water management effectiveness through qualitative and quantitative methods is an important part of the Phase I program.

Sacramento, California's Storm Water Management Program has been in existence since receiving its NPDES Storm Water Permit in 1990. The permit requires the city of Sacramento and three co-permittees (Sacramento County and the cities of Folsom and Galt) to implement a storm water management program.

Location:
Sacramento, California

Affected Waters:
American and Sacramento Rivers

Two rivers, the American and the Sacramento, flow through the city. They are vital elements of the life of the city and are linked closely to the history, economy, and ecology of the area. Recognizing the importance of these two natural resources was a fundamental concept when Sacramento implemented its storm water program. By judging the effectiveness of the program from both a qualitative and quantitative perspective, Sacramento's storm water Effectiveness Evaluation Plan (EEP) expands on the concept of two major components of the city's Storm Water Management program. These two components, the Core Program and the Constituent of Concern Reduction Program, reflect the main functions of the Storm Water Management Program and are explained below:

- *Core Program*

  The Core Program broadly addresses non-storm water and storm water discharges regardless of the level of impact such discharges may have on receiving waters. The Core Program establishes the foundation of the Storm Water Management Program and provides the structure for addressing more specific types of discharges and pollutants. This foundation includes development of legal mechanisms, public awareness of the anatomy and function of the storm drain system, and prevention of non-storm water discharges. Although the Core Program undoubtedly reduces dry-weather discharges, it does not necessarily produce results that can routinely be measured as improvements to water quality in the receiving waters.

- *Constituent of Concern (Pollutant) Reduction Program*

  The Constituent of Concern Reduction Program (COC Reduction Program) identifies and addresses specific constituents found in storm water that have been shown to cause or have the potential to cause pollution in creeks and rivers. The COC Reduction Program should eventually result in measurable improvements to water quality. This component will become a more central focus of the Storm Water Management Program as implementation of some of the Core Program functions become more routine and control strategies for specific pollutants and sources are identified through the ongoing efforts of the monitoring program.

Priority Constituents of Concern

Constituent	Priority
Chlorpyrifos Diazinon Fecal coliform Lead Copper	Tier 1
Zinc Cadmium Chromium PAH compounds	Tier 2
Arsenic Mercury	Further evaluation as COC needed.
Cyanide Fluoranthene Pentachlorophenol Malathion Diuron	Constituent not prioritized due to insufficient data at this time.

Although the impacts of storm water on the beneficial uses of the rivers and creeks in Sacramento and the constituents that cause those impacts are still not fully understood, the permittees are using chemical concentrations that appear to be of the most concern. A ranking of the COCs was conducted in 1995-96. The list of prioritized COCs is shown on the adjacent table.

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Sources:
City of Portland, Environmental Services, 1996. *City of Portland Stormwater Program*, Bureau of Environmental Services.

Contact:
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San Francisco Bay Region: Diazinon Detective Work

Successful Elements Related to Phase I Program:

- The Phase I program provides a framework for a joint-municipality effort to protect a common environment.
- Storm water monitoring focuses management plans to control an environmental threat.

The San Francisco Bay and Delta combine to form the west coast's largest estuary. The estuary is host to a rich diversity of aquatic life. The California Regional Water Quality Control Board, San Francisco Bay Region (Regional Board), in collaboration with bay area municipalities, has detected harmful amounts of the insecticide diazinon in storm water runoff to the bay. Diazinon is a widely applied insecticide used by homeowners and pest control professionals. Toxicologists have found that diazinon causes mortality in the water flea, a common bioassay organism, at the extremely small exposure level of 0.3 nanogram per liter (ng/L or parts per billion). Diazinon's high toxicity and the fact that it is transported by water makes it an environmental threat to the bay and its tributaries.

Location:
San Francisco Bay Region

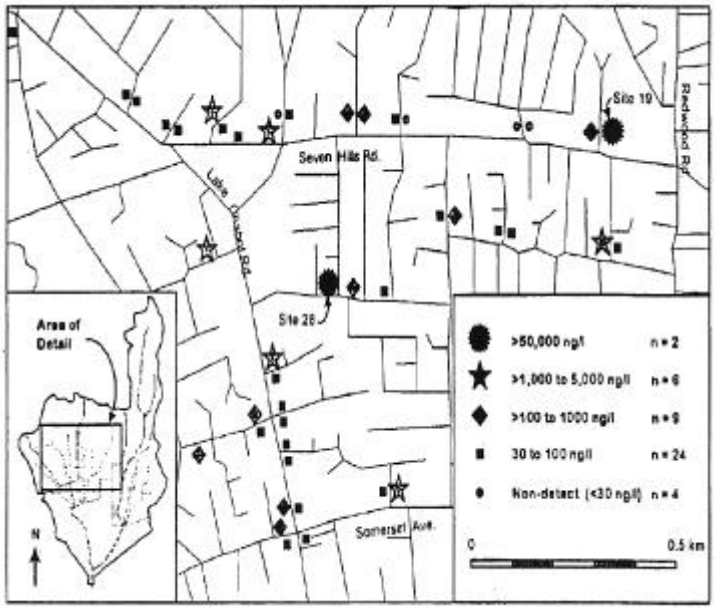
Area:
1,600 square miles

Affected Waters:
San Francisco Estuary

Based on toxicity tests in its waterways, the Regional Board and Bay-area municipalities saw the need to assemble a research team to trace possible locations of diazinon. By checking statistics on diazinon retail sales, the research team started with a region-wide assessment of diazinon usage. Following the review of retail sales records, the team began a prioritized diazinon sampling process throughout the San Francisco Bay to identify the areas with the highest concentrations of diazinon. They found the highest concentrations in small catchment areas feeding urban streams, and both runoff and dry-weather flows contained troubling amounts of the insecticide. Researchers also discovered that despite similarities in catchment size, diazinon loads could not be predicted on the basis of general land cover variables (Watershed Protection Techniques, 1999).

Through subsequent study, the researchers determined that harmful diazinon levels could be produced in urban streams by the actions of only a handful of individual homes. Furthermore, diazinon levels fluctuated greatly among the different outfalls along the same stretch of street (see figure). Even if diazinon was applied in accordance with the instructions for proper application, it was discovered in runoff 3 weeks and even 7 weeks after application. The monitored diazinon concentrations in runoff were frequently more than 1,000 times higher than the 0.3-ng/L level needed to kill water fleas.

San Francisco and associated Phase I communities around the bay are actively seeking to decrease the load of diazinon entering the bay. Efforts include sensitizing residents about the undesired impacts of the pesticide through focused public outreach efforts. In addition, San Francisco is considering a resolution to cease use of all current pesticides until it can identify "reduced-risk" alternatives. The bay municipalities are interested in EPA's ongoing review of diazinon under the 1988 Federal pesticide regulations and want the Agency to propose stringent rules regarding its use.



In summary, because of the NPDES Phase I program, environmental impacts related to storm water have been identified in the San Francisco Bay region and BMPs are being used to minimize environmentally threatening pollutants.

Contact:
Tom Mumly, California Regional Water Quality Control Board, 510 622-2395

Source:
Watershed Protection Techniques, Vol. 3, No.1, April 1999.

Maryland's Management of Dry-Weather Illicit Discharges

Successful Elements Related to Phase I Program:

- Phase I has added illicit discharge control to existing storm water control measures used in Maryland.
- Through a combination of inspection, enforcement, and education, Maryland's MS4s are monitoring and better managing hundreds of storm water outfalls.

Location:

Facility Type:

Affected Waters:

Maryland has a long history of managing its storm water to protect the Chesapeake Bay and its tributaries, including the Maryland Erosion and Sediment Control Law (1970) which controls runoff from construction sites; the 1982 Stormwater Management Act requiring best management practices (BMPs) for postdevelopment controls; and the Chesapeake Bay Program, which established a watershed-wide 40 percent nutrient reduction goal. Even though Maryland's State programs have helped local jurisdictions manage their storm water, the MS4 Phase I program has resulted in additional control measures that are further reducing pollutant loadings.

For example, as a result of the NPDES requirements, dry-weather discharges from MS4s are being characterized and managed. A total of ten MS4s participate in Maryland's municipal NPDES storm water program, including Baltimore City and the counties of Anne Arundel, Baltimore, Harford, Howard, Montgomery, Prince George's, Carroll, Charles, and Frederick. For each of these MS4s, Phase I NPDES requirements have led to field screening of major storm drain system outfalls during dry weather periods and local pollution prevention efforts that have stopped a range of illicit discharges.

Storm drain systems are built ostensibly to convey storm water runoff. However, discharges from storm drain outfalls are not always the result of precipitation. For example, a Sacramento, California, study (Montoya, 1987) indicated that slightly more than half the volume of water discharged from a storm drain system occurred during periods without precipitation. These dry-weather flows originate from a range of sources, some of which do not impose a significant environmental risk (e.g., water line flushing, fire fighting runoff, diverted stream flows, rising ground water infiltration). However, other sources of dry-weather flow are a significant hazard to receiving water quality, including discharges from illegal activities, untreated industrial discharges, and discharges from sanitary sewer pipe cross-connections to the storm sewer system. For example, a study of Allen Creek in Ann Arbor, Michigan (Schmidt and Spencer, 1988) indicated 60 percent of facilities known to use petroleum products or other hazardous materials (e.g., photo processing labs, dry cleaners, and utility companies) discharged inappropriately to the storm sewer system. The wide array of features that must be checked for during dry-weather inspections is shown in Table 1.

Table 1. Features Used to Identify Dry-Weather Illicit Discharges

Floatables	Deposits	Odor	Color
tan scum	oil	feces	pink
brown scum	sewage	musty	black
detergent	orange	stale	metallic
trash	rusty	plastic	blue
sediment	red algae	chlorine	red
oil	metallic scum	cleaning agents	orange
toilet paper	copper	food process	tan
suds	white milky	detergent	

Maryland's effort to help its MS4 permittees characterize illicit discharges, inventory their outfalls, and prevent illicit discharges is progressing, as shown by the highlights in Table 2. These highlights illustrate numerous ways Maryland's MS4s are managing their storm water systems. As shown by the highlights for suburban MS4s (all except Baltimore City), illicit discharges that affect quality during dry-weather periods are not limited to highly urbanized areas. For Maryland, the ongoing characterization of dry-weather discharges based on land use and industry is helping to set monitoring and management priorities. Annual reporting of MS4s to the Maryland Department of the Environment provides the data needed to assess the progress of ongoing management efforts and provides a framework for sharing information on what approaches are the most effective.

Table 2. State of Maryland Management Highlights for MS4 Illicit Discharge	
MS4 Name	**Highlights for the 1997 Management Year**
Baltimore City	The city has focused recently on identifying suspicious connections for pipes 48inches or larger and found that a third of 142 outfalls sampled in priority areas contained high fecal coliform counts indicating potential sanitary leaks to the storm sewer system. Also, the city has developed an automated sampling effort for 67 of the worst outfalls with a history of problems.
Prince George's County	In residential areas, six outfalls had high detergent levels and two had elevated levels of phenols. The phenol problems appeared to be the result of oil dumping and inadequate car maintenance practices. Investigation of these areas showed evidence of oil sheen in the discharges, and surrounding areas exhibited oil stains on paved surfaces. Educational efforts were employed here to rectify these problems. The county has addressed 485 water quality complaints since 1993. The majority of these complaints involved problems associated with dumping trash and debris, sewage, sediment and erosion, vehicle washing, chemical spills, automotive fluids, and general non-stormwater discharges.
Carroll County	Current efforts include a Water Resources Management Program that requires new businesses to propose and implement pollution prevention plans for chemical storage to ensure that illicit discharges do not occur. Educational activities will be a part of the illicit connection program; field screening activities during the permit term will include organized stream walks with citizens and environmental professionals.
Frederick County	The county's illicit connection detection and enforcement program stresses proactive detection and a business-oriented database which will help identify critical industrial and residential outfalls to be monitored at least once every 3 years.

Contact:
William Page (bpage@mde.state.md.us)
Water Management Administration
Maryland Department of the Environment
410 631-3543

Sources:
Dry Weather Flow and Illicit Discharges in Maryland Storm Drain Systems, Maryland Department of the Environment Water Management Administration, October 1997
Montoya, B.I. 1987. Urban Runoff Discharges from Sacramento, CA. CVRWQCB Report Number 87-ISPSS
Schmidt, S. D., and D.R. Spencer. The Magnitude of Improper Waste Discharges in an Urban Stormwater System *Journal WPCF*, July 1986

Ciba Specialty Chemicals: Compliance with Permit Requirements Results in Cost Savings

Successful Elements:

- Collection of storm water first flush eliminates pollutant loading to the Christina River, Delaware.
- Collected runoff is reused as cooling water in industrial operations, thereby saving money and resources by reducing the purchase of water.

Ciba Specialty Chemicals designed an innovative system to meet NPDES Storm Water Phase I permit requirements for the discharge of storm water to the Christina River in Delaware. The system provides the benefits of reuse of pollutant-laden water that would otherwise be discharged straight to the river. The water is used to cool machinery. This approach, developed as part of a site upgrade, makes the control of pollutants in storm water runoff an integral part of overall site management.

Location:
Ciba Specialty Chemicals, Newport, DE.

Industry Type:
Chemical Manufacturing Facility

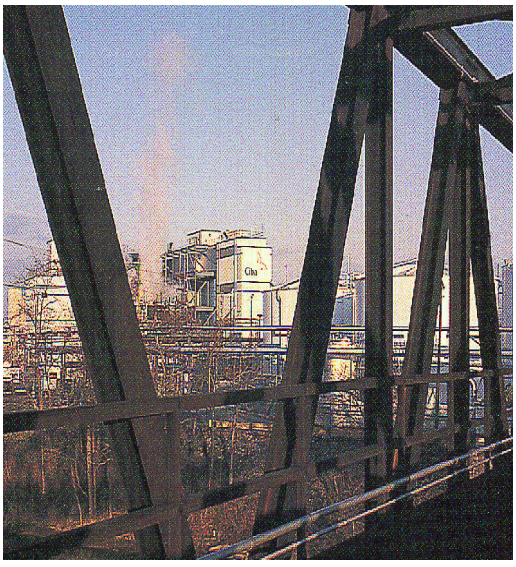
Affected Waters:
Christina River, DE

Before this approach was taken, infiltration created a zinc-laden dry-weather flow to the river, which exhibited toxicity as a result. In addition, high levels of total suspended solids (TSS), a common pollutant found in the first runoff resulting from a storm, were found in the site discharge. After a site assessment, it was decided that both these pollutants could be controlled through design and implementation of a collection system at the site. The collection system eliminates the need to pump ground water to the sanitary sewer or the river, and it provides for the collection of the first flush of storm water runoff.

In addition, the water can be reused and containment of contaminated runoff resulting from an accidental spill or fire is provided, emphasizing the integrated nature of the solution.

The company expects savings in maintenance costs, purchase of water for cooling purposes, and environmental sampling and reporting requirements:

- Annual maintenance savings of $85,000.
- $30,000 annual savings from reduction in purchase of cooling water, expected to increase with expansion of system.
- Number of storm water outfalls reduced from nine to two, giving a large savings in analytical monitoring costs.
- Zero percent mortality (of aquatic organisms) achieved due to containment of zinc-laden discharge.



- Three small accidental spills entirely contained by the system, resulting in no discharge of pollutant.

Contact:
Matthew Watson, Director EH&S, Ciba Specialty Chemicals, (302) 992-5726

Source:
1999 National NPDES Program for Storm Water Control Excellence Awards Application for Ciba Specialty Chemicals Newport Facility

Hoechst Celanese Corporation Coventry Plant: Good Housekeeping Is Good Business

Successful Elements:
- Continuous progression of Storm Water Pollution Prevention Plan and best management practices.
- Programmatic progress.
- Treatment did not generate hazardous waste.

The Hoechst Celanese Corporation (HCC) Coventry Plant is composed of three operating divisions, Specialty Chemical Division, Pharmaceutical Products, and Specialty Group Research Division. These divisions produce organic chemicals, pigments, dyes, and bulk pharmaceutical products. With the promulgation of the Phase I industrial program and NPDES regulations, the facility has been regulated under the Rhode Island Pollutant Discharge Elimination System (RIPDES) since March 1992.

Location:
Coventry, RI

Industry Type:
Chemical Manufacturing Facility

Affected Waters:
South Branch Pawtuxet River, RI

The regulatory requirements of the RIPDES permit consists of five subsections: Best Management Practices (BMPs); Handling of Significant Materials; Herbicide, Pesticide and Fertilizer Usage; Non-stormwater Discharge Certification; and Significant Leaks or Spills. Each of these subsections is used in a specific manner to reduce or prevent pollution in storm water. BMPs are used to address good housekeeping measures, such as properly storing material and posting signs reminding employees of the procedures. Additional procedures and measures are detailed in the Storm Water Pollution Prevention Plan (SWPPP). Handling of Significant Materials provides the location and description of significant materials and uses structural controls to contain materials on site. Since HCC employs a local landscaping company to maintain the grounds, the chemicals used are documented and listed as Herbicide, Pesticide, and Fertilizer Usage. The Non-stormwater Discharge Certification requires HCC to certify that there are no known non-stormwater discharges. HCC is also required to prepare a list of Significant Leaks and Spills and to maintain the list at the facility.

Since obtaining its RIPDES permit, the facility has experienced difficulties with compliance issues as well as additional reissuance requirements. The key issues faced by the facility included the following:

- Continuing to delineate all the subcatchment areas associated with industrial activities. Neither new construction nor cessation of operations was identified or updated in the SWPPP.
- Barrels and pallets were not covered and dye stains on the ground were identified, indicating potential sources of pollution.
- During an inspection, barrels from the facility were viewed in the Pawtuxet River.

Although HCC continues to develop and maintain compliance with the RIPDES industrial storm water program, the company has been able to improve the overall industrial storm water program at the facility. The following are examples of improvements:

- Maintaining a List of Significant Leaks and Spills showed that within 3 years the list more than tripled. It is unlikely that the number of spills increased; it is more likely that the diligence in recording these spill has improved.
- Good housekeeping practices and inspections have increased employee awareness, issues are discussed at shift meetings, and public signs are posted.

Source:
July 1995 NPDES Permit Application for Hoechst Celanese, Coventry Plant

Doggett Auto Parts: BMP Implementation Results in Awards

***Successful Elements*:**
- Aggressive implementation of BMPs.
- Continuous evaluations for opportunities to improve.
- Preventing releases and exposure.

Doggett Auto Parts is a full-service auto recycling facility in Bryan Texas. It stores 1,000 cars in its yard and dismantles about 20 cars a month. Since 1994 the facility has implemented a storm water pollution prevention plan (SWPPP). The plan was revised in October of 1997 to implement new best management practices (BMPs) for vehicle storage and dismantling operations at the 5-acre site. Each of the seven employees is trained to implement the requirements of the NPDES storm water program.

Location:
Bryan, TX

Industry Type:
Salvage yard

Affected Entity:
Carters Creek

In 1997 Doggett moved from the Baseline Permit to the Multi-Sector General Permit. As a result the company continues to implement site-specific BMPs. The following 10 practices illustrate the variety of BMPs Doggett has used as part of the SWPPP:

(1) Use of drain tables to collect extracted fluids, which minimizes fluid contact with the ground. This practice also reduces the amount of waste fluid contact with storm water discharges.
(2) Recycling and reuse of antifreeze from all vehicles.
(3) Evacuation and recycling of R12 and R134a Freon. This eliminates any possible release to the environment.
(4) Use of a "gas buggy" to remove gasoline from each vehicle for use in company vehicles and equipment. The use of the gas buggy eliminates any possibility of leakage or spillage.
(5) Secondary containment for the outside oil storage tank and storage of waste oil drums on a concrete pad and under cover.
(6) Inside storage of removed motors, transmissions, radiators, tires, batteries, etc.
(7) Use of wheel stands for stored, unprocessed vehicles to facilitate site inspection for fluid leaks.
(8) Location of parts washing in a dedicated wash bay. Settling of solids in the wastewater occurs before discharge to the local POTW.
(9) Annual employee SWPPP training, including emergency response and BMP implementation.
(10) Tasking employees with observing, reporting, and initiating corrective action.

As result of BMP implementation and dedication to good environmental practices Doggett Auto Parts has been recognized for its efforts:

- Automotive Recyclers Association (ARA) approved Doggett as a Certified Automotive Recycler.
- Awarded Gold Seal Quality Program status .
- Nominated for the 1998 National Storm Water Control Program Excellence Award for an industrial program.

Contact:
D.J. Rufino
409 778-7536
Source:
1998 National NPDES Program for Storm Water Control Excellence Awards, application for Doggett Auto Parts

Empire Castings: Total Suspended Solids Reduced by 90 Percent

Successful Elements
- TSS runoff has been reduced by 90 percent.
- Affordable, durable, and effective best management practices.

In cooperation with EPA Region 6 and the Oklahoma Department of Environmental Quality (OK-DEQ), Empire Castings worked with other local foundries to identify effective and economically feasible multimedia solutions for achieving compliance with environmental regulations applicable to the foundry sector. For its work, Empire Castings was awarded second place in the industrial category for the 1996 National Storm Water Control Excellence Awards.

Location:
Tulsa, OK

Industry Type:
Ductile/Gray Iron Foundry

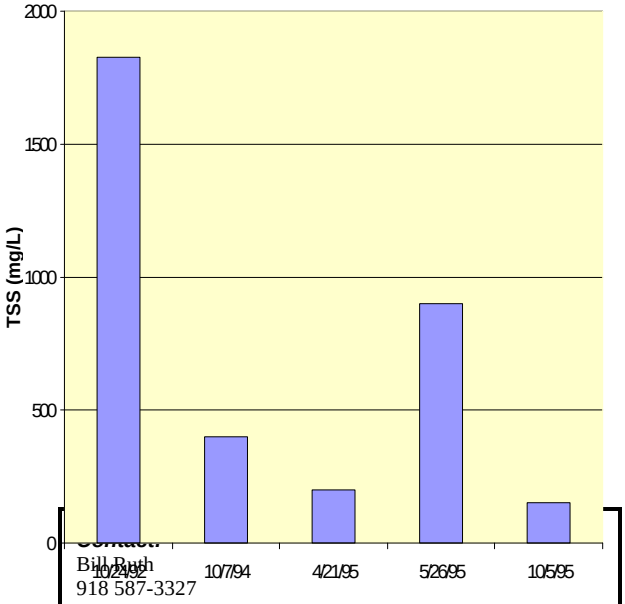
Affected Entity:
City of Tulsa, OK Storm Sewer System

Prior to this initiative, an examination of Empire Castings, a sand-mold foundry, revealed TSS in storm water to be a major concern, with storm water sampling indicating TSS levels in excess of 1800 mg/L (October 1992). New operating procedures incorporating best management practices were implemented. These procedures included routine dry sweeping to prevent sand drag-out to exposed site areas. Gutters were installed, and berms were constructed to divert potentially contaminated storm water for treatment. Preliminary studies for this site revealed that straw bales were ineffective at reducing TSS levels in storm water and were not durable over the long term. However, a filter system consisting of railroad ties and a woven fabric mesh at the outlet of the retention ponds proved durable and effective at reducing TSS discharge levels to less than 150 mg/L (October 1995). Empire Castings incurred an initial labor and materials cost of $8,455 to achieve this initial reduction in TSS, with an annual cost anticipated at $16,462 to employ a dedicated worker to dry sweep high-traffic areas, remove settled solids from the retention ponds, and maintain the filter system.

To further reduce TSS levels, Empire Castings conducted a major cleanup of the foundry floor at a cost of 700 man-hours ($5,355). Installation of additional lighting aided workers in minimizing routine sand drag-out and maintaining clean conditions. Empire Castings believed these housekeeping measures, in addition to diverting and filtering roof runoff would be sufficient to achieve the additional reduction necessary to achieve compliance with the September 29, 1995, standard of 100 mg/L.

Benefits from the implementation of the storm water program include the following:
- A dramatic reduction in site visits by the city of Tulsa required to clean local storm drain sites.
- Higher productivity rates and training for staff on storm water controls.
- A 90 percent drop in TSS concentration levels.

Empire Casting,
TSS Stormwater Concentrations (mg/L)



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Source:
1996 National NPDES Program for Storm Water Control Excellence Awards, application for Empire Castings

Pratt Auto Salvage & Sales, Inc.: Storm Water Pollution Plan Makes Salvage Yard a Good Neighbor

Successful Elements

- Facility has obtained a 100 percent removal rate.
- Discharge drainage ditch from site contains minnows and other aquatic life.
- Partnered with Arkansas Automotive Dismantlers Recyclers Association and Automotive Recyclers Association.

The 20 acre Pratt Auto Salvage & Sales Inc. site located near downtown Hoxie, Arkansas, engages in the wholesale distribution of motor vehicle supplies, accessories, and tools and new motor vehicle parts. In addition, the facility processes 70 to 80 aging and damaged cars each month. The site is located next to a school and an apartment complex.

Location:
Hoxie, AR

Facility Type:
Salvage yard

Affected Waters:
Turkey Creek, Black River

Because of the types of vehicles brought to salvage yards, leaked fluids and exposed parts can contaminate storm water and potentially ground water. To prevent such contamination from occurring and to comply with the storm water permit issued by the Arkansas Department of Pollution Control and Ecology in 1993 as part of the Phase I regulations, Pratt developed a storm water pollution prevention plan (SWPPP) with the guidance of the Arkansas Automotive Dismantlers Recyclers Association and the Automotive Recyclers Association. The goal of the plan is to recycle 100 percent of the vehicles while averting contamination of the environment. The plan consists of six parts: Pollution Prevention Team, Identification of Potential Pollutants, Practices for Elimination or Reduction of Pollutants in Dismantling Process, Facility Maintenance, Equipment Maintenance, and Employee Training.

The facility was able to obtain a 100 percent pollutant removal rate. The Pratt facility drains vehicles of all fluids in a covered buildings with a cement floor. Fluid drained from the vehicles is removed from the site by an independent contractor. The vehicles are then either dismantled and sold for scrap or relocated to the storage areas outdoors. During the years the facility has been operational and maintaining an SWPPP, the salvage yard area has been free of oil, rust or waste associated with fluids from automobiles. Based on storm water sampling conducted, Pratt's SWPPP is effective in complying with industry standards and EPA targets.

In recognition of the BMPs, in 1995 Pratt received first place in the Improvement-Beautification Contest from the Automotive Dismantlers and Recyclers Association and earned the highest level of auto recycling designation (Gold Seal Certified Automotive Recycler) In 1998 Pratt received the first award presented to industry by the Arkansas Department of Environmental Quality. Finally, Pratt is honored by receiving children on field trips from the neighboring school. They come to observe Pratts operations and view the drainage ditch in the salvage yard, which is home to minnows and other aquatic life.

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Source:
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